# Getting to Net Zero Working Group: Energy Networks Snap-Shot Report

## Executive Summary

The electricity gas and heat networks are finding it necessary to increase their ad hoc interactions as they develop their contribution to the net zero[1] targets for green house gases for the UK and Scotland. The organisations involved in the "Getting to Net Zero" working group are all directly engaged in the energy sector encountering day-to-day challenges around how to include "getting to net zero" in their operations. The working group met to consider the progress of networks to date in addressing net zero and to identify immediate actions that would remove barriers to progress. This snap shot report summarises the working group findings.

For networks, the challenges around decarbonising heat and transport in getting to net zero, are one of the largest unknowns and will require greater cross sector interaction. There is recognition that more information exchange, a common vision of demand evolution and a degree of co-ordination in networks' investment and planning are now necessary.

Based on the real uncertainties around the evolution of energy demand and the decarbonisation of gas, electricity, heat and transport, the working group strongly support focus on gaps in the existing evidence base to allow evaluation of different approaches. Equally important is the prioritization in the next 3-4 year period of the demonstration of solutions which explore different approaches to decarbonising electricity gas and heat.

The working group recognise that a positive, fair, and affordable customer experience coupled with positive economic impacts will be at the centre of a successful decarbonisation process. Hence any policy led proposal affecting a domestic or industrial customer arising from the net zero objectives should be able to demonstrate how customer satisfaction is to be achieved.

The working-group propose that the following should be pursued by policy makers and the network operators as a matter of priority:

- The UK Government, the Scottish Government, Network operators and Ofgem should require that the evaluation of the customer experience is a robust and meaningful part of all publicly funded projects around energy networks.
- The energy networks (heat, electricity, gas and transport) should jointly identify a commonly acceptable process to create a shared vision of demand evolution against which to plan their approach to contributing to the net zero targets that would also form part of future price reviews. A common view has been developed by the ENA but this did not involve wider stakeholders including policy makers. The ENA, National Grid and academic experts should make initial proposals on how to proceed to ensure a workable long-term approach that will help to identify future policy requirements.
- Ofgem's regulatory remit should be reframed through appropriate changes in legislation to require Ofgem to take cross network issues into account in exercising their customer interest duties regarding the reduction of greenhouse gases, as it impacts network planning and operation. Recommendations from the national infrastructure commission report on the direction of regulation across sectors should be taken into account.

[1] "Net Zero-the UK's contribution to stopping global warming", 2019, Committee on Climate Change, London. https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

Each network has immediate requests for change, which requires policy, and regulatory change in their specific industry. These, with Low/ No Regrets actions and the main questions for the networks around further action in getting to net zero, are listed in the report.

## Introduction

The net zero targets adopted by both UK and Scottish governments in 2019 have triggered many questions for planning across the energy sector. How to get to the targets? Increasingly academics and policy makers are talking about “the whole energy system”. This is an evolving concept whereby advantages in resource efficiency and decarbonisation flow from co-ordination between the different energy networks in operation and planning of assets.

The working group members are all directly engaged in the energy sector today and are aware of a ground level move towards more exchange between existing networks. Based on an initial white paper proposal the working group members met in 3 sessions to consider the role of energy networks in the overall complex challenge of getting to net zero.

This snapshot report gives a considered assessment, by the group as to how much of an energy system approach exists today in gas, electricity and heat networks as well as a perspective on the future interaction with transport. The comments are GB relevant, with specific focus on the situation in Scotland. The report looks at the nature of network interaction today, what the benefits of a system approach might be for citizens and customers and identifies some of the gaps in the current evidence base around what an energy system approach could deliver.

## Energy networks today

Domestic, commercial and industrial energy customers, have different requirements for heat, power, and transport. The networks that deliver the energy are not universally available, but customers in urban areas will probably have ready access to two or three. Electricity and liquid fuel are generally available. Gas reaches around 84 % of domestic customers in the UK and 79 % in Scotland. Heat networks are limited to specific locations reaching 2% of current heat demand. The networks are operationally connected to some extent: generation is dependant on gas for some electricity generation, thermal energy in heat networks is prominently derived from or using gas or electricity, energy storage capacity is available in heat and gas networks. These network interactions are typically driven by the electricity systems needs for resilience and seasonal adjustments.

The electricity and gas networks are regulated bodies, whose physical structure is based on their historic centralised operation. They operate with very high delivery quality standards, they are regulated and organised to prevent monopolistic practises and encourage competition, and they tend to be risk averse.  Their structures have historically not focused on co-operation due to limited levels of interaction. Heat networks are naturally monopolistic in their structures and regulation is in progress. Historically, predominantly relatively small in scale the main interaction with the rest of the system is as a customer connecting the energy centre. The proposed shift to larger, strategic heat networks in future is likely to require closer infrastructure planning.

## Current level of co-operation across networks

Interaction between the networks occurs without comment today through their customers’ participating in the markets for power and gas.  As described above the networks have a physical and operational interaction.
As more decentralised, smaller generation joins the electricity network, as heat networks are actively supported by government policy, as transport is encouraged by policy to move to decarbonised fuel more interaction is beginning to emerge in the gas, electricity, transport and heat sectors. Today this is a set of ad hoc exchanges on specific topics with three main areas of discussion:

- Operational information exchange.

Participation in demonstration projects necessary to explore innovation has increased exchanges between networks as have challenges in decarbonisation of heat and moves to decarbonise transport fuel. The Energy Networks Association (ENA) a UK trade association whose members include electricity and gas operators has created the "Open Networks Project",[2] in which topics of current interest are explored across networks to assist networks in managing the current carbon reduction driven transitions.

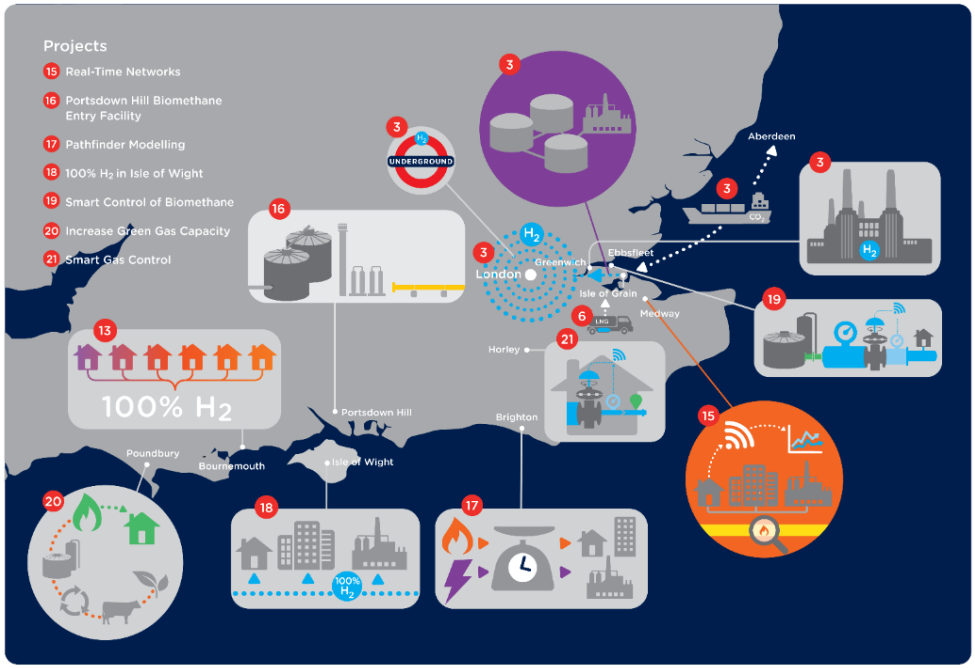
- Network planning

Gas and electricity network operators produce ten-year statements of future network plans. To prepare themselves for decarbonisation, networks are increasingly seeking evidence on the likely evolution of energy demand. National Grid's Future Energy Scenarios[3] is widely cited in this context. The policy shift to encourage Electric Vehicle (EV) use has required electricity networks to talk with the transport sector to better understand how demands could evolve. Decentralisation of generation and the links between heat networks and Combined Heat and Power plants means that heat networks are increasingly familiar with gas and electricity network requirement

- Innovation demonstration and deployment of multi-network decarbonisation solutions[4].

There is a growing number of innovation, demonstration and deployment projects (Figure 1) using several networks in a system approach or investigating specific network developments. Projects such as HyDeploy, H21, H100, Aberdeen Vision and Cavendish, pilot approaches to aspects of decarbonised gas fuel. Other projects such as Methiltoune or Warwick Campus look at a whole system approach to energy supply in decarbonisin

Figure 1: Examples of network innovation and decarbonisation of gas network in South East England




[2] "The ENA Open Networks Project", ongoing. http://www.energynetworks.org/electricity/futures/open-networks-project/
[3] "Future Energy Scenarios", 2019, National Grid. http://fes.nationalgrid.com/
[4] Appendix 1 shows a sample of the wide range of implementation and demonstration projects which are raising awareness around network interaction and specific decarbonisation approaches

## Status today: planning for a system approach

As well as the ten-year network development plans, gas and electricity transmission owners are preparing their business plans out to 2026. These consider the longer-term requirements to help facilitate net zero. The net zero targets of zero net greenhouse gas emissions by 2050 in the UK and 2045 in Scotland are too recent to be included in the existing plans however, the networks are, beginning to consider the impacts for their networks. In all these plans there is limited consideration of the interaction of one network with another. The exceptions are where, as in the case of transport, the change from motor vehicles to electric vehicles is treated as growth in a new customer sector or where there is an interaction requirement, i.e. the availability of fuel, which is included as an assumption of basic operational.

- Gas network planning in Scotland: The SGN Ten-Year Long Term Development Statement is being followed in 2019. SGN work with independent consultants using market indicators to project demand for the period 2018/19 to 2027/28. The plan also looked at National Grid's Future Energy Scenario (FES) and makes useful comparisons with FES on the different approaches taken between the two. (SGN base case using historical trends, FES assuming the end point of 2050.) SGN has commissioned work via independent consultants to extrapolate the FES Community Renewables Scenarios to understand better the challenge of decarbonisation.
- Power network planning in Scotland: The SP Energy Networks Transmission Draft Business Plan 2021-2026 identified investment requirements for Central and southern Scotland transmission network across this period. This is informed by the SPT Future Energy Scenarios 2019, which draws on the National Grid Future Energy Scenarios and considers various scenarios projecting future supply and demand trends. Until 2026 SPT sees major investment to facilitate the ongoing growth in renewable generation across Scotland. The changes in demands for electricity are limited with a focus on reinforcing the boundary between transmission and distribution. It is expected to be after 2026 before the rapid uptake of EVs will have some impact on the transmission network. The impact of electrifying transport and heat will have a much more profound impact on the distribution network. SP Energy Networks and SSEN have recently announced a £7.5m project with the Scottish Government to deliver more electric vehicle charge points and examining the impact on the electricity network.
- Heat Networks planning in Scotland and UK: The UK Government's Heat Networks Investment Project (HNIP) and Heat Networks Delivery Unit (HNDU), and Scottish Government's Low Carbon Infrastructure Transition Programme (LCITP), coupled with the promise of regulation, are driving the heat network sector's future projections for expansion and decarbonisation. The expansion is based on the assumption of successful implementation of a range of standards and policies around buildings, planning and decarbonisation. The heat industry's resulting projections of heat network growth suggests that by 2050 17% of domestic heat and 24% of industrial heat will be provided through heat networks. Whilst heat networks do not currently have any regulatory requirements on decarbonisation, the industry has been responding to the direction of travel of government policy and begun looking at decarbonisation pathways – including flexibility between large-scale heat pumps and the electricity grid.
- Transport Planning in Scotland: Transport Scotland is working to achieve Scottish Government decarbonisation objectives and targets. This has triggered discussion, co-operation and projects with the several delivery partners. The plan involves a shift to sustainable transport for Scotland by 2050, with the detail of the "who" and "how" of that transition still in analysis.

It is clear from the working group discussions that none of the networks has confidence to predict or to project changes in supply or demand beyond 2030 due to the high uncertainties in current modelling, projections and behaviours. This makes long term planning very difficult and decisions based on projections carry a high level of risk. The likely evolution of heat

demand, the evolution of transport and the assumptions on increased energy efficiency, (appliances, buildings and processes) in scenarios and projects were discussed. It is difficult to see a consistency in expectation of demand evolution across the networks, though FES is frequently referenced. There is also a concern around how the network obligations in price, service and satisfaction can be delivered to customers while delivering net zero. The current level of domestic customer satisfaction[5] for example with existing heating systems (Figure 2) is good, with over 80% fairly or extremely satisfied (Scotland: gas and electricity available). This suggests that large group change to low carbon alternatives will not be spontaneous unless these changes offer equivalent or better performance and benefits. This contributes to the overall uncertainty given the level of building fabric intervention and product or behavioural change expected of domestic customers in currently proposed decarbonisation approaches.

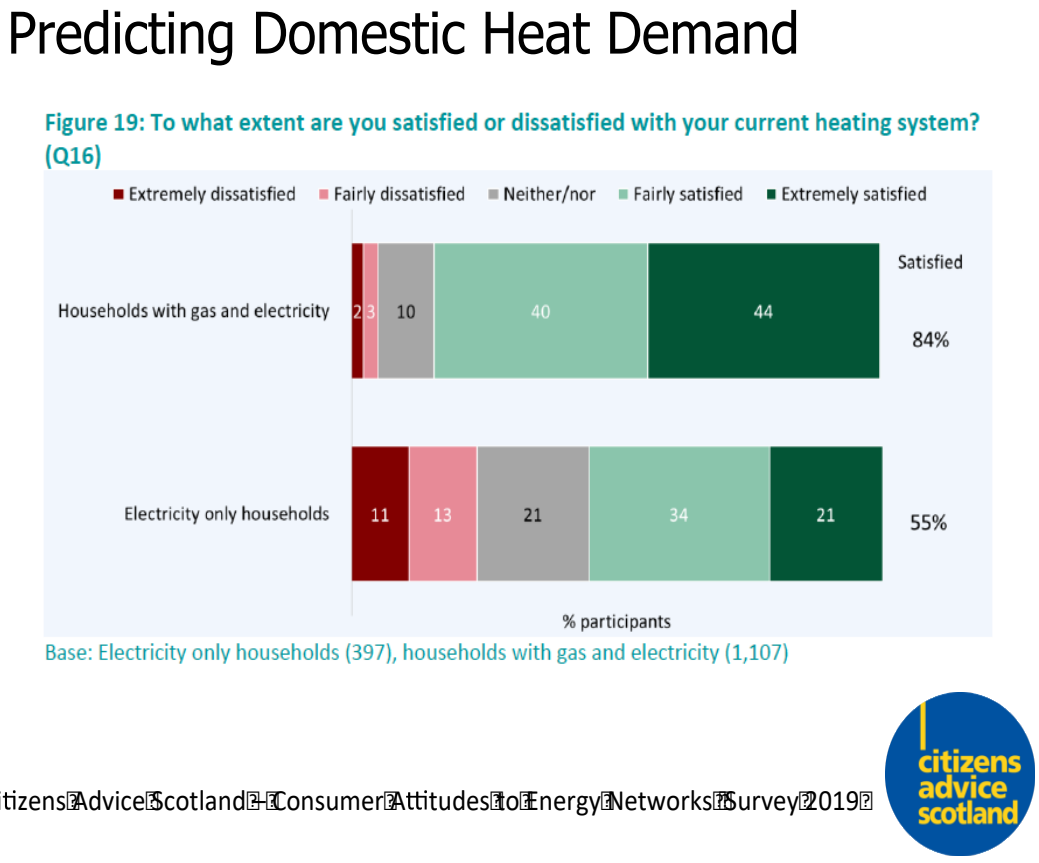



Figure 2: Consumer attitudes to Energy Networks Survey 2019, Citizens Advice Scotland

## Status today: benefits of energy system approach to network operation

[5] Citizens Advice Scotland – Consumer Attitudes to Energy Networks Survey 2019

Evidence of the benefits of a stronger system approach to network planning and operation is being actively explored in several institutes, university departments and individual projects.[6] However the bottom up actions around operational information, and joint demonstration by the networks suggests that a common interest exists. The growing awareness of the impact on customers of the costs of decarbonisation has led to a real and immediate interest in exploring a level of strategic, organisational and future planning change that could minimise overall cost. Ultimately, the interest is in lowering the risk cost of future network investment against a shared set of consumption and operation projections. This coupled with suitable participation of the networks in the regional planning process should reduce unnecessary duplication of assets and service failure, as well as minimising customer disruption.

### Status today: benefits of energy systems approach for citizens and customers

There are some possible areas of citizen benefits in a more system approach to energy demand at the network operation level. The network customer pays for network development through charges so ultimately the avoidance of unnecessary duplication of assets and the co-ordination of investment could lower the additional cost to the customer.

Exchanging various types of operational information between networks will help networks to manage their assets and to be ready to respond to changes in the other networks operation. This can strengthen the resilience of the system as a whole, and could deliver a more co-ordinated experience for the customer in times of difficulty.

An appropriate focus by the networks on informed, energy-system-aware network planning should allow networks to engage more effectively with physical planning and regional and city decarbonisation ambitions. At the same time opportunities for innovation, skills building, and enterprise will develop around an emerging energy system approach. Taking advantage of the investment to develop local skills and link to existing strengths such as digital skills in Scotland would mean that emerging techniques developed in the move to a more system approach could build capability in the UK and Scottish economy.

### Status today: the main questions for networks in working towards net zero.

The reality of the current trend in electricity and gas consumption in Scotland is that it is flat or decreasing (Figure 3). This is driven historically by increased appliance efficiency and structural energy efficiency improvements in buildings. For the electricity networks distributed and behind the meter generation is also contributing. Market indicators which are used in the annual cycle of the 10-year grid planning cycle tend to reflect these trends in the planning period to 2026. While electricity demand is currently declining, it is expected that this will reverse with the increased electrification of heat and transport.  The resultant

[6] For example: National Centre for Energy Systems Integration, Newcastlehttps://www.ncl.ac.uk/cesi/; The energy Systems Catapult https://es.catapult.org.uk/ https://es.catapult.org.uk/; Warwick University Campus, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/691643/Heat_Network_Case_Study_Brochure.pdf ; Research at a range of universities such as Warwickhttps://warwick.ac.uk/research/priorities/energy-grp?tag=energy+management

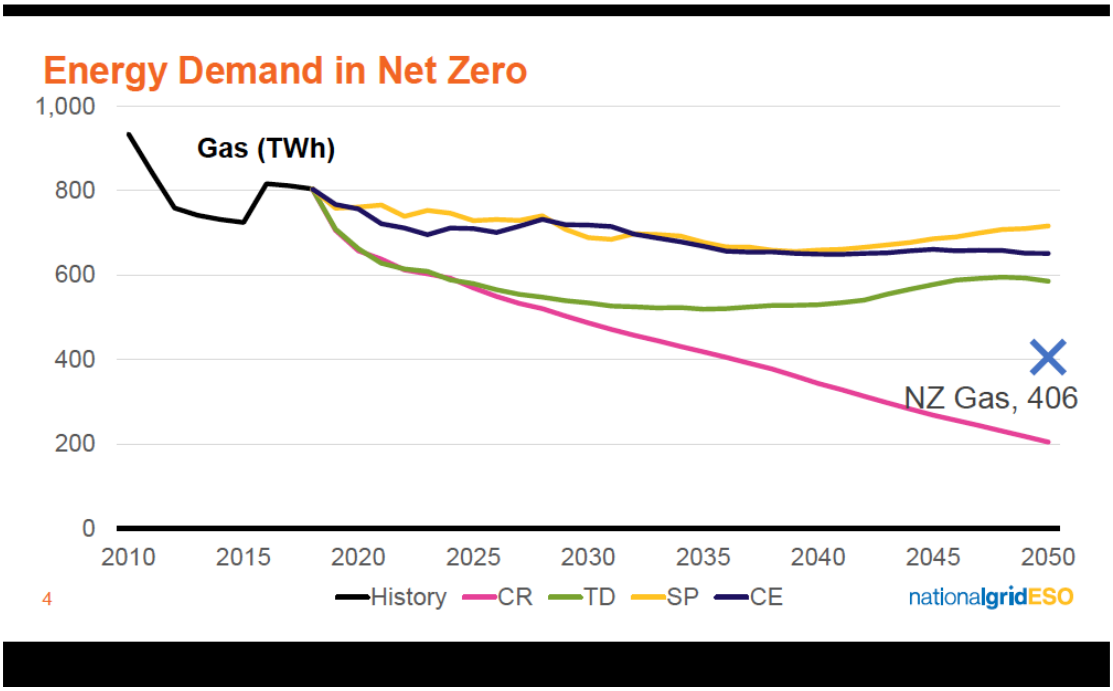



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Figure 3: Gas and electricity consumption 2010 onwards with projections to 2050 from 2018. demand on networks and generation will increase the need to pursue a multi-vector approach

With demand currently flat and the risk associated with the investment, and hence the cost of investment beyond 2030 high, the Low/No Regrets actions for industry, policy makers and government include evidence gathering and demonstration of new network technologies, modes of operation and fuel decarbonisation. Likewise a substantial effort by policy makers and industry to understand what people today want from the future energy system. There is an opportunity to prioritise building this foundation for policy and action in the short to near term, (3 to 4 years).

The working group set out to identify consensus actions and key questions shared across the networks. By addressing these some of the bumps can be smoothed in the road ahead for networks in getting to net zero.

## What we can do with the tools we have?

Each network expressed concern about their ability to make fair and successful changes without active interest from their customers. The working group recommends that the customer and citizens in their various societal roles be put at the heart of all proposed changes. A positive, fair, and affordable customer experience coupled with positive economic impacts has to be a central aim of a successful decarbonisation process. A strategy which relies on behavioral change suddenly appearing so that citizens reduce demand, switch fuel and invest substantially in the energy efficiency of their homes is a high risk strategy and difficult for the network companies to reflect in their planning processes. Rather, the wider energy sector and policy makers should continue to listen to customer feedback and use innovation, technology, new business models, and new and old technology to develop for the energy users a truly desirable future sustainable energy world.

In the context of decarbonisation, the working group highlighted the forthcoming price reviews under Ofgem as representing an opportunity for change in regulation. These reviews currently occur every five years and it is important not to miss the immediate opportunity. What these price controls say about decarbonisation and multi-vector supply is crucial to what happens over the 7-9 year period.

Each network has its own list of "No/Low Risk" actions to start on now through their own organisations, professional and industry bodies and to discuss with government. Some of these involve changes to existing standards, legislation and regulatory oversight.

- Electricity Network: Given the substantial changes that are anticipated across the networks, network operators should review the investment decision criteria that have been traditionally applied for appropriateness in current situation. Particularly consider a move away from lowest cost and towards encouraging the sizing of assets for better total life value of the investment given the increased number of likely projects as demand changes. Ofgem should similarly review its investment decision criteria for appropriateness to the current challenge of the new net zero targets.
- Gas Network:
    - The gas networks should accelerate and fully implement the iron mains replacement program.
    - The gas networks should work with the biomethane industry, to maximise the volume of green gas entering the network.
    - Working with policy makers and regulators the gas network operators should identify and help rapidly remove barriers to immediate decarbonisation such as changes to the Gas Safety (Management) Regulations, to appropriately increase the flexibility offered by the gas network to accept more low carbon gas.
    - The gas networks with the electricity networks should implement a charter for whole systems, building on the work of the Open Networks Project.
- Heat Networks: BEIS and Scottish Government should introduce a future-proofed, principles-based regulatory framework for heat networks that addresses demand risk and allows for investment in low carbon heating solutions. In anticipation of regulation, the heat network sector should itself establish decarbonisation pathways for their networks, considering both how these pathways will interact with other energy and transport networks, and sharing information, data and learnings where appropriate.
- Transport: Priority coordination of private and public investment for the move to sustainable transport.
- All networks participating in the working group support:
    - Nominating an expert third party process to help the networks build a common vision of the evolution of energy demand in getting to net zero, which contains an assessment of the likelihood of different pathways developing and the main drivers for the assumed change.
    - Establishing and adopting common criteria for a structured approach to reducing the risk for investors in assessing sustainable investment such as the EU taxonomy report published in June 2019[7]. This contains technical screening, of a range of technologies, a methodology and worked examples for the assessment and guidance and case studies for investors.
    - Building on the work carried out in the Open Networks Project (ENA) in which regulators and policy makers work with the networks to address the legislative and regulatory barriers to increased appropriate operational information exchange

[7] https://ec.europa.eu/info/publications/sustainable-finance-teg-taxonomy_en

between networks. This to improve the service to the customers and enable further decarbonisation.

- Provision in the remit of the networks
  1) For networks to work with new energy regional spatial planning processes such as in Scotland arising from the National Planning Framework, NPT 4 starting in 2020. The working group supports proposals that that major networks be a statutory consultee on development and other relevant plans.
  2) For networks to have the net zero targets recognised in their own planning process via Ofgem's existing customer interest duties regarding the reduction of greenhouse gases or otherwise.

- The demonstration projects regarding decarbonisation currently underway can significantly help improve the technical understanding of the operational benefits of an energy system approach. There may be additional areas for demonstration of technology and certainly for customer engagement and satisfaction that should be considered for funding.
  - BEIS, Scot Government, Industry and Ofgem should include the evaluation of the consequential customer experience as a required part of all publicly funded projects around energy networks.
  - Networks operators should identify the additional demonstration projects that would significantly improve their operation and their ability to plan investment and to work with the public funding bodies and private funders to deliver the projects.
  - Ofgem should address the imbalance between networks funding for innovation through the Innovation Allowance and the Innovation Competition. The long term value of good demonstration projects in the coming two to three years is considerable.

## What are the key questions?

Getting to net zero is a complex challenge with actors required in all sectors of the economy. The following are key questions for the energy networks which the networks on their own cannot address but which need immediate attention from the identified parties if progress is to be made.
UK policy makers

- Within the duties of Ofgem the definition of "consumer interest" includes the reduction of greenhouse gases on the same level as security of supply. The net zero targets arguably heighten the challenge of this duty. What are the changes needed in Ofgem's current remit for them to carry out this duty now? Should requirements for customer protection in the area of reduction of greenhouse gases be strengthened accordingly? A clear immediate question from the networks is how will Ofgem take into account the different policies and targets adopted by devolved governments in implementing regulation? Similarly, how are local (city/community) level targets to be reflected in regulation in a consistent and equitable fashion?
- "Who should pay for readying the networks for Getting to Net Zero?" This is an active issue facing the networks. A current example of the challenge is in the funding of the electric vehicle charging network. These charges today fall on all electricity customers, while the benefit lands with a small number of people in a position to buy an electric vehicle. Decarbonisation is a public good. Her Majesty's Treasury (HMT)[8] have announced a review of funding (November 2019) which will look at mechanisms to "create an equitable balance of contributions". The working group adds its support to the timely completion of this work as

[8] "UK Treasury Net Zero Revue", UK Government. https://www.current-news.co.uk/news/net-zero-review-to-be-released-in-autumn-2020

a priority and suggests that faced with the unique challenge of the public good nature of the net zero challenge a fundamental review of all approaches to funding the transition is warranted.

- How do we develop a robust approach to valuing developments across and between networks? Is the current tariff and charging structure applied to different fuels fair and supportive of decarbonisation (heat, gas, electricity and transport) in a co-ordinated de carbonisation challenge? In the context of heat de-carbonisation for example the recovery of policy costs through the electricity bills makes electric heating relatively more expensive compared to gas – adding to the challenge. More generally there are a range of challenges with charging structures that are not designed with the need to deliver net zero in mind. (Sustainability First Report, "What is Fair?"[9])
- How is regulation best aligned? As transport shifts fuel over the period 2020-2030, who will represent the customers "access to transport" interest in the change? The National Infrastructure Commission is currently considering network regulation. The working group support a start now on more co-ordination between regulatory bodies within their immediate remits and an identification of barriers to that co-ordination so that these can be addressed.

To Policy makers, wider energy sector and networks.

- Policy makers and industry should critically evaluate how much they are counting on customer behavioural change in getting to net zero and whether it is reasonable? Customers have expectations and make choices and these should be intensively explored in the next 3-4 years. There is a great deal of anxiety around implementing the changes, which appear at this point to be necessary in the process of getting to net zero. Both industry and policy makers need to ask whether they know enough about citizen and customer constituencies to formulate policies and products that will be adopted as they hope.

To Academia

- What evidence gaps exist in understanding the value of a more integrated approach to planning and managing the energy supply channels (heat, electricity, liquid fuel and gas)? What policy approaches could be recommended on the base of evidence? Is there benefit in evaluating which policies have been used so far in decarbonising energy and what worked and what didn't?
- How can academia assist the networks and policy makers in developing a process for a rolling common vision of energy demand evolution, and decarbonisation which can be shared across networks, allowing the cross network investment options to be properly evaluated including in the context of better risk assessment.

## Concluding remarks from the working –group.

The energy networks are finding it necessary to increase their interactions on an ad hoc basis as they seek to respond to the legislatively driven decarbonisation programme, and net zero targets, in the UK. The challenges of the decarbonisation of transport and heat are far larger than that of decarbonising electricity, which preceded them. The challenges are across and between networks. There is a growing belief that more informational exchange, a common vision of demand evolution and a degree of co-ordination in networks investment and planning are now necessary. This moves the energy networks closer to a system approach to energy delivery

[9]www.sustainabilityfirst.org.uk/images/publications/other/Sustainability_First_Future_Energy_Market_Discussion_Paper_September_2019.pdf

## Appendix 1: Energy system, decarbonisation and network interaction projects.

The following is a sample list of the demonstration and deployment projects with system and decarbonisation elements in which the networks and members of the working group are engaged to day.

Electricity Networks Sectoral Interests

- Electric Vehicle Infrastructure preparation

A partnership between Scottish Power Energy Networks, Scottish and Southern Energy Networks and Scottish Government to demonstrate and model the infrastructure needs of electric vehicles:
The project will examine what electricity network infrastructure will be required to support the increasing number of people travelling to the north of Scotland by electric vehicles. Infrastructure needs for new charging points along the route of the Electric A9 will be identified and mapped. This Strategic partnership will allow partners to efficiently evaluate the relationship between renewable electricity generation, the distribution network, and public electric vehicle charging infrastructure, to make sure all drivers across Scotland have equal access to the electric future.
( https://www.spenergynetworks.co.uk/news/pages/new_strategic_ev_partnership_marks_important_step_towards_clean_energy_for_transport.aspx)

- Developing flexibility capacity, rather than additional infrastructure through market mechanisms.

SP Energy Networks is currently looking to procure up to 95MW of flexibility services to assist particular areas within both SP Distribution and SP Manweb during times of constraint. Competitive tenders addressing specific postcodes in England Wales and Scotland are included.
https://www.spenergynetworks.co.uk/pages/flexibility.aspx

- The Green Economy Fund which we are using to support local initiatives:

SP Energy Networks have committed to contribute up to £20m to support initiatives that will benefit the people of Scotland and support Scotland's ambitious green energy plans and local economic growth.
( https://www.spenergynetworks.co.uk/pages/green_economy_fund.aspx)
A summary of the successful projects funded to date are
here: https://www.spenergynetworks.co.uk/pages/round_1_projects.aspx

Hydrogen sectoral interests .

- BIGHIT

BIGHIT is creating an exemplar Hydrogen territory in Orkney. BIG HIT will demonstrate the Orkney Islands of Scotland as a replicable Hydrogen Territory, using curtailed renewable energy generated locally to produce hydrogen which can then be used as a clean energy vector to store and use valuable energy for local applications. The hydrogen will be used near to the point of production on Eday and Shapinsay wherever possible. (Joint FCH and Innovate UK project)
https://www.bighit.eu/about

- H2 Aberdeen. Funders Joint FCH and Innovate UK

**H2 Aberdeen is an initiative working to bring about a hydrogen economy in the Aberdeen City Region. It will help to reinforce the area's position as an energy city, now and in the future.**

About Hydrogen, as an energy storage medium, offers an opportunity to maximise the capacity of renewable energy.

With the transferable oil and gas expertise in the North East of Scotland, as well as a capacity for renewable energy generation, there is an  to further enhance our economic competitiveness by being at the forefront of a hydrogen economy.(http://www.h2aberdeen.com/

- Aberdeen Buses

Key industry and public sector players have joined forces to fund and deliver the World's largest demonstration of hydrogen fuel cell buses in Aberdeen, realising an aspiration to become a world-leading city for low carbon technology.
The Aberdeen Hydrogen Bus Project is made up of two separate European funded projects, High Vlo City, which funds 4 buses and HyTransit which funds 6 buses, both of which are supported by the Fuel Cells and Hydrogen Joint Undertaking(FCHJU).( http://www.h2aberdeen.com/home/H2-Aberdeen-hydrogen-bus.aspx)

Gas Networks Sectoral interests

H100 https://www.sgn.co.uk/about-us/future-of-gas/hydrogen/hydrogen-100
Our H100 project is looking to construct and demonstrate the UK's first network to carry 100% hydrogen. The project is built-up of a series of smaller projects that focus on each key aspect of hydrogen research. These will develop the evidence to enable us to progress towards the construction and physical operation of the UK's first 100% hydrogen network.
Aberdeenshire, it will also influence locations beyond Scotland via the national network systems.

- Methiltoune

Project Methilltoune seeks to prove the resilient bulk supply of zero-carbon hydrogen to support the demonstration of a scalable 100% hydrogen gas network. Phase 2 will allow for the construction and demonstration of hydrogen production and storage from offshore wind. The combined Methilltoune and H100 system will evidence how bulk hydrogen production can be produced in a scalable manner through electrolysis of renewable sources to meet the demands of domestic heating. The system will also identify and demonstrate the associated cost reduction pathways while maintaining a resilient and secure supply of energy.

- Cavendish

https://www.smarternetworks.org/project/nia_nggt0143
To undertake a feasibility study to help support the potential of the Isle of Grain as a location for hydrogen production and storage.

- HyDeploy https://hydeploy.co.uk/

As the first ever live demonstration of hydrogen in homes, HyDeploy aims to prove that blending up to 20% volume of hydrogen with natural gas is a safe and greener alternative to the gas we use now.  It will provide evidence on how customers don't have to change their cooking or heating appliances to take the blend, which means less disruption and cost for them.  It will also confirm initial findings that customers don't notice any difference when using the hydrogen blend.

Heat Networks sectoral interests

- Leeds PIPES scheme: https://www.leeds-pipes.co.uk/ - The Leeds PIPES project is an example of a strategic district heat network, with 16.5km of pipe already installed and now providing low carbon heat to homes and buildings across the city with customers receiving lower carbon and competitively priced heat. The council plans to grow the network over several phases to the city centre and southbank and hopes to receive funding from the Heat Networks Investment Project,to allow this. It is an example of the type of network that UK Government is encouraging to come forward. Alongside installation of the heat network, the project is connected to Veolia's Recycling and Energy Recovery Facility, and supported by an energy centre that provides resilience to the network. The Leeds PIPES project will reduce carbon emissions by 11,000 tonnes per year once fully built out. The scheme is also installing communications ducts to allow installation of super-fast broadband, in line with West Yorkshire Combined Authority's plans to take a whole system approach (https://www.westyorks-ca.gov.uk/media/2424/leeds-city-region-energy-strategy.pdf). Phase 2 is currently being installed in partnership with Connecting Leeds which is radically transforming the Headrow to improve public transport and improve public realm.
- Shetland NINES: http://www.ninessmartgrid.co.uk/ - Shetland is not connected to the national electricity network, and has had to manage the ageing infrastructure on the islands. SHEPD, supported by Ofgem and government, is delivering a smart grid by flexibly managing generation assets, the heat network and thermal store, and energy demand on the grid. Shetland has a lot of wind energy, but not enough demand to use it - the installation of smart heaters and thermal storage has allowed for the storage of this excess capacity, reducing costs for consumers in Shetland, and reducing the use of fossil-based generation.
- Gateshead Heat Network: https://www.flexitricity.com/knowledge-centre/press-release/gateshead-district-energy-project-earns-1million-boost-demand/ - Gateshead Council has partnered with Flexitricity to deliver flexible response from the heat network assets. The Gateshead network has a thermal store, allowing the network to absorb excess renewables at times of low demand and high generation for later use on the network. This partnership has unlocked £60,000 per year of revenue over the next 15 years by using the network's flexibility to smooth out electricity demand. The interaction between heat networks and the Grid can help to reduce costs for consumer bills on both sides
- Warwick University :https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/691643/Heat_Network_Case_Study_Brochure.pdf - The University of Warwick aims to be net-zero carbon from its energy usage by 2030. A whole system decarbonisation approach is a cornerstone of the energy strategy. Over the last ten years, networks and generation technologies have saved in excess of 35,000 tCO2. The whole system approach, embedded in the university master plan, has seven core strategies. (1) Significantly increase buildings fabric insulation and efficiency to reduce energy demand, close to Passive standard. (2) Integrate electrification of transport and promotion of significant sustainable forms of transport to travel to and from local stations. (3) Optimise energy storage opportunities, co-developing battery storage capabilities and trialling on the campus. (4) Raise awareness of the university community for efficient use of energy and resources. (5) Smart campus and artificial intelligence operating system supported by superfast 5G broadband. (6) Transition of the heating / cooling network to $4^{th}$-$5^{th}$ generation district heating. (7) Finally, build on the university 20km heating / cooling network to connect renewable energy generation and remove fossil fuels.

## Appendix 2: Working group members and evidence received (with thanks)

The Getting to Net Zero Working Group was convened by the IMechE Power Industry Division, the Scottish Fuel Cells and Hydrogen Association, Energy at Edinburgh, University of Edinburgh and later joined by The Centre for Energy Policy Strathclyde University, and are the authors of the "Getting to Net Zero Working Group: Energy Networks Snap-Shot Report"
The working group members are all directly engaged in the energy sector today and gave input to inform the report. The working group met in 3 sessions between 16th September and 21st of October to consider the role of energy networks in the overall complex challenge of getting to Net Zero. The meetings were held in compliance with the EU rules to avoid anti-competitive behaviour and the information used throughout is public domain.

### Members of the working group:

Martin Hill, SP Energy Networks
Colin Thomson & James Higgins, SGN
Charlotte Owen, ADE
Nigel Holmes, SFCHA
Robert Gibson, National Grid
Maxine Frerk, GridEdge Technology
Phil Lawton, Energy Systems Catapult
Gareth Harrison & Harry Van de Weijde, Energy at Edinburgh: University of Edinburgh
Antonios Katris & Christian Calvillo Munoz, Centre for Energy Policy: Strathclyde University
Fiona Riddoch, Edinburgh Innovations

### Additional input to the working group was given by:

Citizens Advice Scotland,Transport Scotland, Edinburgh Planning

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